

Simultaneous Measurement of Emittance, Transmittance and Reflectance of Semi-Transparent Materials at Elevated Temperature

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Optically transparent glasses and ceramics have been widely used for many applications at high temperature, such as infrared(IR) heat-seeking devices for missile guidance, optical window materials for gas lasers, thermal barrier coatings of aircraft and gas/jet turbine blades, thermal protection of sensitive electronic components, and thermal insulation for furnaces. However, it has been thought that, in particular, the measurement of the optical properties of IR windows is very difficult and challenging at elevated temperatures, owing to their semi-transparency. In particular, IR optical properties at high temperature should use different devices or environments for each of the IR properties (i.e., emittance, or transmittance), preventing direct comparison of the properties. Therefore, we have recently developed a new technique, called the two-substrate method (TSM). In this present work, we will show simultaneous determination of emittance, transmittance, and reflectance of semi-transparent materials at elevated temperatures under the same environment with a single measurement. The method is very useful in measuring the optical properties of glasses and ceramics, and is important for high temperature applications. We will demonstrate that the TSM will give infrared optical properties of sapphire at high temperature as well as those of alumina, a representative porous material.